

Part 2–Pending Claims with Markings and Indications to Show New Changes

1.     (Original~~Amended Once~~) ~~A graded index of refraction~~ An optical  
waveguide formed in an integrated circuit-like structure having a substrate,  
comprising:

        at least one layer of dielectric material positioned above the  
substrate and defining a trench having side walls, the dielectric material having an  
index of refraction;

        a refractive layer of optically transmissive material adjoining the side  
walls within the trench and conforming to the side walls, the refractive layer having  
an index of refraction; and

        a core of optically transmissive material adjoining the refractive layer  
within the trench and conforming to the refractive layer, the core having an index  
of refraction; and wherein:

        the index of refraction of the core is greater than the index of  
refraction of the refractive layer, and the index of refraction of the refractive layer is  
greater than the index of refraction of the dielectric material.

2.     (Original) A waveguide as defined in claim 1 wherein:

        the refractive layer surrounds the core except on one side; and

        the dielectric material contacts the core on the one side where the  
refractive layer does not surround the core.

3.     (Amended Once) A waveguide as defined in claim 2 wherein:

        the refractive layer is U-shaped and surrounds the core except on  
the one side.

4.     (Amended Once) A waveguide as defined in claim 1 wherein:

        the refractive layer is U-shaped and surrounds the core except on  
the one side; and further comprising:

        a cap of the refractive material extending across the one side of the  
core between ends of the U-shaped refractive layer, the cap adjoining and  
conforming to the core and the refractive layer, the cap having essentially the  
same index of refraction as the U-shaped refractive layer; and wherein:

the cap and the U-shaped refractive layer encircle the core.

5. (Amended ~~Once~~Twice) ~~A graded index of refraction~~An optical waveguide formed in an integrated circuit-like structure having a substrate, comprising:

at least one layer of dielectric material positioned above the substrate and defining a trench having side walls, the dielectric material having an index of refraction;

a first refractive layer of optically transmissive material adjoining the side walls within the trench and conforming to the side walls, the first refractive layer having an index of refraction;

a second refractive layer of optically transmissive material adjoining and conforming to the first refractive layer within the trench, the second refractive layer having an index of refraction;

a core of optically transmissive material adjoining and conforming to the second refractive layer within the trench, the core having an index of refraction; and wherein:

the index of refraction of the first refractive layer is greater than the index of refraction of the dielectric material, the index of refraction of the second refractive layer is greater than the index of refraction of the first refractive layer, and the index of refraction of the core is greater than the index of refraction of the second refractive layer.

6. (Original) A waveguide as defined in claim 5 wherein:

the first and second refractive layers surround the core except on one side; and

the dielectric material contacts the core on the one side of the core where the first and second refractive layers do not surround the core.

7. (Amended Once) A waveguide as defined in claim 6 wherein:

the first and second refractive layers are each U-shaped;

the second U-shaped refractive layer surrounds the core except on the one side of the core; and

the first U-shaped refractive layer surrounds the second U-shaped refractive layer except on the one side of the core.

8. (Original) A waveguide as defined in claim 7 further comprising:

a cap of the refractive material extending across the one side of the core between ends of one of the first or second U-shaped refractive layers, the cap extending between the core and the dielectric material, the cap having essentially the same index of refraction as the U-shaped refractive layer to which the cap is connected; and wherein:

the cap and the one of the U-shaped refractive layers to which the cap is connected encircle the core.

9. (Original) A waveguide as defined in claim 7 further comprising:

a first cap of refractive material extending across the one side of the core between ends of the first U-shaped refractive layer, the cap adjoining and conforming to the core and the refractive layer, the cap having essentially the same index of refraction as the first U-shaped refractive layer;  
and

a second cap of refractive material extending across the one side of the core between ends of the second U-shaped refractive layer, the second cap having essentially the same index of refraction as the second U-shaped refractive layer;

the first cap adjoins and conforms to the dielectric material and the second cap;

the second cap adjoins and conforms to the core and the first cap;

the first cap and the first U-shaped refractive layer encircles the second cap and the second U-shaped refractive layer; and

the second cap and the second U-shaped refractive layer encircles the core.

10. (Original) A waveguide as defined in claim 5 wherein:

the first refractive layer is formed by deposition in a self-aligned manner with the trench;

the second refractive layer is formed by deposition in a self-aligned manner with the first refractive layer; and

the core material is formed by deposition in a self aligned manner with the second refractive layer.

11. (Original) A waveguide as defined in claim 1 wherein:

the refractive layer is formed by deposition in a self aligned manner within the trench.

12. (Original) A waveguide as defined in claim 1 wherein:

the refractive layer completely encircles the core.

27. (Previously Added) A waveguide as defined in claim 11 wherein:

the core is formed by deposition in a self aligned manner within an opening of the refractive layer extending along the trench.

28. (Previously Added) A waveguide as defined in claim 1 wherein:

the refractive layer and the core are located within the trench.

29. (Previously Added) A waveguide as defined in claim 4 wherein:

the refractive layer and the core are located within the trench.

### Part 3--Remarks

This Amendment and Response is responsive to the office action mailed October 23, 2001. In that office action, claims 1-12 and 27-29 were objected to because of informalities in description; claims 1-4, 11, 12 and 27-29 were rejected under 35 USC 103(a) as obvious from Lee (U.S. patent 5,281,305); claim 5 was noted as allowable if rewritten or amended to overcome the objection; and claims 6-10 were objected to as dependent upon a rejected based claim but was noted as allowable if rewritten in independent form.

Reconsideration of these objections and rejections is respectfully requested. Claims 1-12 and 27-29 are now pending in the application.

#### Description Objection

There is no statutory or other legal authority asserted in the office action as a basis for the objection to the use of "graded index of refraction" in the claims. The basis for the objection appears to be that the assertion that the use of the term does not comply with the usual and customary meaning of the term.

Both the case law and PTO recognize that an applicant can be his or her own lexicographer. Page 15 of the application describes the "graded" nature of the refractive indices of the present invention, both structurally and functionally. This description makes it clear that the term is used in the present application in a sense which encompasses both discrete transitions of changing refractive indices and continuously variable refractive indices. The last paragraphs of claims 1 and 5 also make this point clear, because continuously variable and a transitionally variable refractive indices both incorporate the graded or changing refractive indices between the core, reflective layer(s) and the outer dielectric as recited in the claims. The usage in the application appears to be consistent with the graded index of refraction usage in U.S. patent 5,949,942 to O'Connor, which has been mentioned but not cited in the office action.

Thus, the use of the term "graded index of refraction" in the specification is consistent with the usual and customary meaning of the term. The claims also use the term to encompass continuously variable and transitionally variable aspects of

the refractive indices. There is no basis for limiting the claims to exclude a continuously variable refractive index.

Without limiting their encompassing scope, the claims have been amended to eliminate the reference to a “graded index of refraction.” The use of “graded index of refraction” in the preambles of claims 1 and 5 is not necessary in view of the limitations which define characteristics of the waveguide in the last paragraph of these two independent claims. Claims 1 and 5 have been amended to refer to an “optical waveguide,” rather than a “graded index of refraction waveguide.” Such an amendment is not made for purposes of patentability, because the meaning of the claims has not changed and because the last paragraph of claims 1 and 5 defines the optical features in a way that is consistent with a continuously variable or transitionally variable graded index of refraction.

For these reasons, it is believed that the objection to the claims should be withdrawn. If the examiner continues to assert this objection, it is respectfully requested that the examiner cite legal authority to support such an objection and to explain comprehensively the reasoning for such a continued objection.

#### Objected-To Claims

Claim 5 has been noted as allowable if the objection is overcome. For the reasons set forth above, it is believed that there is no valid basis for objecting to claim 5. Accordingly, claim 5 is believed to be allowable.

Claims 6-10 depend on claim 5, and should be allowable in conjunction with claim 5, as noted in the office action.

#### Obviousness Rejection

The office action explicitly bases the obviousness rejection only on Lee. However, the reasoning for the rejection also refers to O'Connor (5,949,942). The status of and reliance on O'Connor in the rejection is therefore uncertain. Indeed, O'Connor has never been formally cited as a reference during examination. Reconsideration of the obviousness rejections of claims 1-4, 11, 12 and 27-29 is respectfully requested, regardless of whether the rejection is based solely on Lee, or on a combination of Lee and O'Connor.

The office action acknowledges that Lee does not describe the difference in refractive indices as explicitly stated in the last paragraph of claim 1. The applicant agrees that Lee's disclosure does not teach the graded index of refraction feature recited in the last paragraph of claim 1. More specifically, not only does Lee fail to disclose the graded index of refraction feature, but Lee also fails to suggest any reason for a graded index of refraction feature. Lee teaches that the optical layers have approximately the same refractive indices as one another, and even further, that the silicone dioxide layer in which the optical layers are retained has essentially the same refractive index as the optical layers.

Since the refractive index of the borosilicate glass and the silicon dioxide are nearly equal, the structure can be represented (optically) as shown in Fig. 13. Waveguides 20 and 30, therefore, essentially reside in a single index medium with the medium acting as a cladding thereabout. (Lee, column 3, lines 66 to column 4, line 3.)

Since Lee does not teach or suggest anything but single refractive indexes for all of the components of his optical waveguide, Lee itself is legally insufficient as a basis for the obviousness rejection of the pending claims which specifically require differences in the refractive index of the dielectric material, refractive layer and core. Stated differently, the only suggestion in the record for a graded index of refraction in the claimed subject matter is the applicant's own disclosure. It is impermissible hindsight to use the applicant's own disclosure as the basis for an obviousness rejection. Any rejection based only on Lee inherently utilizes hindsight as a basis for that rejection.

As to the combination of Lee with O'Connor, Lee fails to suggest any reason for incorporating subject matter from O'Connor. O'Connor seems to focus on making the optical waveguides in a corrugated form, and is therefore not concerned with the claimed integrated circuit -like structure. Therefore, neither reference suggests a combination with the other. Any benefit of combining O'Connor with Lee is recognized only from the applicant's own disclosure. Lacking any suggestion of combination in either Lee or O'Connor, the obviousness rejection is insufficient.

The reasoning expressed in the office action for combining Lee and O'Connor in the rejection is as follows:

It would have been obvious to one of ordinary skill in the art to have graded index of refraction as claimed in the invention of Lee in order to refract greater amount of light energy into the core, rather than allowing the light energy to be lost in the surrounding dielectric material. (October 23 office action, p. 3)

Such an argument adopts the improvements of the applicant's own disclosure as the basis for the combination. Nothing in Lee suggests such optical improvements or advantages, and nothing in O'Connor suggests improvements or advantages in an integrated circuit-like structure as is claimed. The basis for a valid obviousness combination must reside in the references themselves, not in the applicant's own disclosure.

The office action states that the applicant's arguments of August 27 have been fully considered but have not been found persuasive. No reasons were given for the alleged lack of persuasiveness. Indeed, the obviousness rejection in the October 23 office action appears to copy essentially the same wording in the obviousness rejection of the first office action of March 30, 2001. There is no explanation of the lack of persuasiveness.

In view of the failure in the October 23 office action to respond to the applicant's previous arguments, the continuation of essentially the same rejection without further clear explanation, and the uncertain status of O'Connor in the rejection itself, it is respectfully requested that any further rejection must provide the applicant with an adequate opportunity to comprehend the rejection, the reasoning for continuing the rejection, and an opportunity to respond. It would therefore appear to be inappropriate to make final any further rejection.

#### Conclusion

In view of these amendments and remarks, it is believed that all pending claims now define patentable subject matter, and the application is in condition for allowance. If not, the Examiner is encouraged to telephone the undersigned for



the purpose of resolving any additional issues that might inhibit the immediate allowance of this application.

Respectfully submitted,

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